Inexpensive semiconducting organic polymers can harvest sunlight to split carbon dioxide into alcohol fuels

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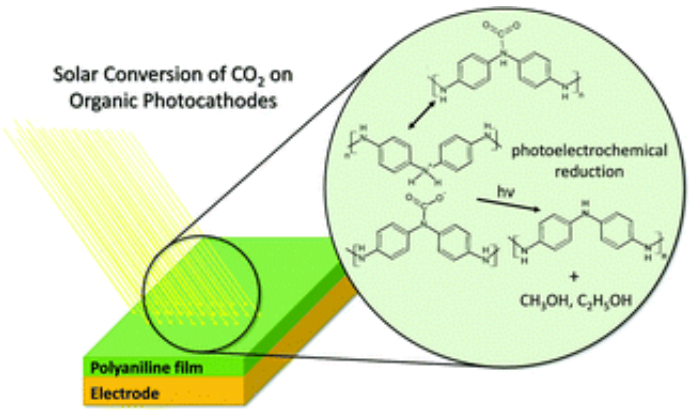

Credit: RCS

Chemists at The University of Texas at Arlington have been the first to demonstrate that an organic semiconductor polymer called polyaniline is a promising photocathode material for the conversion of carbon dioxide into alcohol fuels without the need for a co-catalyst.

"This opens up a new field of research into new applications for inexpensive, readily available organic semiconducting polymers within solar fuel cells," said principal researcher Krishnan Rajeshwar, UTA distinguished professor of chemistry and biochemistry and co-Director of UTA's Center for Renewable Energy, Science & Technology.

"These organic semiconducting polymers also demonstrate several technical advantages, including that they do not need a co-catalyst to sustain the conversion to alcohol products and the conversion can take place at lower temperatures and use less energy, which would further reduce costs," Rajeshwar added.

Rajeshwar and his co-author Csaba Janaky, professor in the Department of Physical Chemistry and Materials Science at the University of Szeged, recently published their findings in The Royal Society of Chemistry journal *ChemComm* as "Polyaniline films photoelectrochemically reduce CO2 to alcohols."

In this proof-of-concept study, the researchers provide insights into the unique behavior of polyaniline obtained from photoelectrochemical measurements and adsorption studies, together with spectroscopic data. They also compared the behavior of several conducting polymers.

The stationary currents recorded after two hours during testing suggests that the polyaniline layer maintained its photoelectrochemical efficacy for the studied time period. While in the gas phase, only hydrogen was detected, but potential fuels such as methanol and ethanol were both detected in the solution for carbon dioxide-saturated samples.

"Apart from these technical qualities, as a polymer, polyaniline can also be easily made into fabrics and films that adapt to roofs or curved surfaces to create the large surface areas needed for photoelectrochemical reduction, eliminating the need for expensive and dangerous solar concentrators," Rajeshwar added.

Frederick MacDonnell, chair of UTA's Department of Chemistry and Biochemistry, underlined the importance of this research in the context of UTA's focus on global environmental impact within the Strategic Plan 2020: Bold Solutions|Global Impact.

"Dr. Rajeshwar's ongoing leadership in research around new materials for solar fuel generation is vital in a world where we all recognize the need to reduce the impact of carbon dioxide emissions," MacDonnell said. "Finding an inexpensive, readily-available photocathode material could open up new options to create cheaper, more energy-effective solar fuel cells."

Rajeshwar joined the College of Science in 1983 and is a charter member of the UTA Academy of Distinguished Scholars. He is the newly appointed president of the Electrochemical Society, an organization representing the nation's premier researchers dedicated to advancing solid state, electrochemical science and technology.

He is an expert in photoelectrochemistry, nanocomposites, electrochemistry and conducting polymers, and has received numerous awards, including the Wilfred T. Doherty Award from the American Chemical Society and the Energy Technology Division Research Award of the Electrochemical Society. Rajeshwar earned his Ph.D. in chemistry from the Indian Institute of Science in Bangalore, India, and completed his post-doctoral training in Colorado State University.

More information: Dorottya Hursán et al. Polyaniline films photoelectrochemically reduce COto alcohols, *Chem. Commun.* (2016). DOI: 10.1039/C6CC04050K

Provided by University of Texas at Arlington